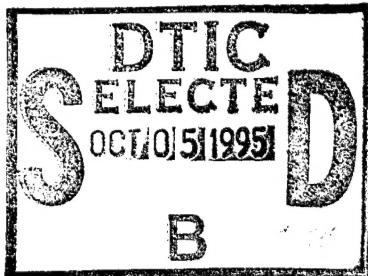


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High Performance Computing Methods and Systems for Partial Differential
Equations

Period September 1, 1992 - February 28, 1995

July 19, 1995

A. PROJECT RESULTS

In this report we list the personnel that worked under this AFOSR grant, the publications completed and describe the accomplishments of various projects. The results under this contract include:

PDEPACK: The PDE solving system PDEPACK has been designed and a prototype made operational. Its objectives are

- Provide a software framework for PDE solving,
- Integrate major public domain PDE solvers and libraries,
- develop parallel discretization methodologies and sparse/iterative solvers.

The status of the software in PDEPACK is as follows:

Already Incorporated

ELLPACK	MGGAT
//ELLPACK	PATRAN
FIDISOL	PCGPACK
VECFEM	PDECOL
NSPCG	PDEONE
Sparskit	LINPACK
CVD RCTR	VERSE
CADSOL	CFD

In Process of Being Incorporated

PTS
PDETWO
OCEAN
MP PCGPACK2

Being Studied for Incorporation

LAPACK
ACM Algorithms 392,494,533,572,593,651
IMSL
DLEARN

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PDELab: PDEPACK is the basis for PDELab, a problem solving environment for high performance PDE applications. Its objectives are

- A generic environment to specify PDE models,
- A unified interactive PDE solving environment,
- Assistance in making decisions at all levels of PDE solving.

The software architecture for PDELab has been completed and a prototype is operational. PDELab is a general problem solving environment for high performance PDE based applications; it is based on the solvers in PDEPACK. Two application specific problem solving environments have been designed to be built on top of PDELab. One, called BioSeparation Lab, is operational. It incorporates a PDE model of the chemical engineering process along with online connections to actual experimental apparatus so the process can be controlled. The second one is still being built; it is to model and control the Chemical Vapor Deposition process used to make microchip wafers.

PYTHIA: The PDELab prototype incorporates the expert system *PYTHIA* which

- Uses exemplar and neuro-fuzzy based learning to guide the selection of software and hardware for PDE applications.
- Has a knowledge base facility that automatically generates value to support "smart" sequential and parallel PDE solvers.

WWW Servers: A prototype World Wide Web based server for PDELab has been designed and is operational. It allows a user on the internet to solve elliptic PDEs using //ELLPACK (a subset of PDELab) on our server and its associated parallel machines. This system is being enhanced and extended for all of PDELab.

Basic Research: A variety of more basic research results have been obtained to:

- Analyze the performance of parallel computation
- Analyze numerical methods for partial differential equations
- Analyze the partitioning of PDE problems for parallel computation.

B. PERSONNEL

Work on this grant has involved the following people:

John R. Rice*(Co-PI)	Professor of Computer Science
Elias N. Houstis*(Co-PI)	Professor of Computer Science
Apostolos Hadjidimos*	Visiting Professor of Computer Science
Catherine E. Houstis	Visiting Assoc. Professor of Computer Science
Cheryl Crabill*	Programmer
Manolis Vavalis*	Postdoc
Mo Mu*	Postdoc
Ko Yang Wang*	Postdoc
Nicholas Chrisochoides*	Ph.D. candidate
Sanjiva Weerawarana*	Ph.D. candidate
Sang Bae Kim	Ph.D. candidate
Scott McFadden	Ph.D. candidate
Hyeran Byun	Ph.D. candidate
Yu-Ling Lai	Ph.D. candidate
Po-Ting Wu	Ph.D. candidate
Mei-Ling Shyu*	Ph.D. candidate
Chi Chui*	Ph.D. candidate
Winnie Lap-kan Ng*	Ph.D. candidate
Pelayia Varodoglu	M.S. student
Jim Berniger*	M.S. student
Athanasios Gaitatzes	M.S. student
Margaret Gaitatzes	M.S. student, Programmer
Shahani Weerawarana	M.S. student
Hongtao Gu*	M.S. student
Konstantios Pantazopoulos*	M.S. student
Jeffrey Michael*	M.S. student
Meletis Samartzis*	Visiting Research Associate
Stavros Kortesis	Visiting Scholar

Those names with stars have received some direct AFOSR support, the others have research support from related projects.

C. EXTERNAL HONORS

John R. Rice

- *ACM Service Award*: Assoc. Comp. Mach., March 1993.
- *CRA Service and Leadership Award*: Computing Research Assoc., July 1993.
- Elected to National Academy of Engineering, 1994.
- Sigma Xi Award for Outstanding Research by Purdue Faculty Member, 1994.
- Appointed to editorial board of IEEE Computational Science and Engineering, 1994.

- Appointed Academic Advisory Board of Industrial Research Institute, 1995.

D. PUBLICATIONS

We list the publications that have resulted from the past three years of work supported by the AFOSR. These include:

- 13 Journal papers
- 3 Papers submitted for journal publication
- 14 Refereed Conference papers
- 1 Book edited
- 1 Ph.D. Thesis
- 7 Papers in books/proceedings

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14. A. Hadjidimos and D. Noutsos, On a matrix identity connecting iteration operations associated with a p-cyclic matrix, *Linear Algebra Appl.*, **182** (1993), 157–177.
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16. M. Mu and J.R. Rice, Modeling with collaborating PDE solvers – Theory and practice. *Contemporary Mathematics*, **180**, (1994), 427–438.

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30. P. Wu and E.N. Houstis, A parallel mesh generation and decomposition methodology, *Proceedings of Mesh Generation Conference*, Albuquerque, October 1994.

3. BOOKS, BOOK CHAPTERS, AND PUBLICATIONS IN BOOKS/PROCEEDINGS

3.A. Books

31. E.N. Houstis and J.R. Rice, *Artificial Intelligence, Expert Systems and Symbolic Computing*, North-Holland, Amsterdam (1992).
32. S. Weerawarana, *Problem Solving Environments for Partial Differential Equation Based Systems*, Ph.D. Thesis, Department of Computer Sciences, Purdue University, 1994.

3.B. Publications in Books and Proceedings

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